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An Approach Towards Development Of Sustainable Concrete Paving Blocks Using Construction And Demolition Waste

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Abstract : *Construction Industry is second largest industry in India. When a structure is demolished, the Construction and demolition (C&D) waste generates large amount of solid waste in urban areas causing harmful effect on the surrounding environment. The study aims towards development of sustainable paving blocks using C&D waste for different proportions of recycled fine aggregates to find the best combination for getting desired properties. In this study C&D waste was used in the casting of concrete paving blocks by replacing it with fine aggregates in proportions of 0%, 20%, 40%, 60% & 80%. The compressive strength of paving blocks was evaluated. The results showed that more strength is achieved between the range of 40% to 60% replacement of fine aggregate with C&D waste fine aggregate and maximum compressive strength is obtained with 50% replacement, saving 25% of total cost of fine aggregate. This substantially reduces the adverse effect on environment.*

Keywords-*Compressive strength, Construction and Demolition (C&D) waste, Concrete paving blocks, sustainable, Percentage replacement of fine aggregates*

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I. Introduction

A. Use Of Paver Block

Concrete paver blocks are used at various locations according to its need& strength like Building premises, monument premises, landscapes, public gardens/parks, domestic drives, paths, embankment slopes, sand stabilization area etc.

B. Need And Significance Of Reuse Of C&D Waste

A huge quantity of construction and demolition (C&D) wastes is produced every year .Due to the introduction of metro in India most of the constructions on its route is getting demolished. Hence the disposal of this waste has become a severe social and environmental problem in the territory. The possibility of recycling of these wastes in the construction industry is thus of increasing importance. In addition to the environmental benefits in reducing the demand on land for disposing the waste, the recycling of C&D wastes can also help to conserve natural materials and to reduce the cost of waste treatment prior to disposal. C&D waste in construction industry is as follows

Table No: - 1Type of C&D waste material

SR.NO	*TYPE OF MATERIAL*	*INERT (%)*	*NON INERT (%)*
1	Road work material	95.7	4.3
2	Excavation soil	97.9	2.1
3	Demolition material	82.8	17.2
4	**Site clearance material**	**64**	**36**
5	Building renovation material	62.1	37.9

Table No: -2Composition of site clearance material

Constituent in%	Percentage contribution	
Concrete	19.99	**53.09**
Reinforced concrete	33.1	
Dirt, Soil, mud	11.91	46.91
Others	35	
Total	100	

Successful application of recycled aggregate in construction projects has been reported in some European and American countries. While this type of material has been used in a large amount in non-structural concretes or used as road bases, its use in structural concrete is limited. Therefore we have selected concrete paver block for study.

C. Objective Of Study

1.To find the properties of recycled fine aggregates by performing tests related to aggregates.
2.To cast the paving blocks of M30 grade and perform the tests as per IS 15658:2006 and compare the properties with the conventional paving block for various praportions.

D. Methodology Adopted:

The C&D waste was collected from Hotel Fountain Inn near Kalewadiphata and all the test on the material are performed as per IS standard and the results found are in the given range. The location of site is kalewadiphata, Pune, Maharashtra, India.
To get more precise percentage of C&D waste for getting maximum compressive strength, we have divided the work into two stages i.e. stage-I & stage-II. Stage-I consist of range of replacement of C&D waste fine aggregate percentage like 0%, 20%, 40%, 60% & 80%. And after getting the final range in which maximum compressive strength obtained we have decided to split the range by 5% to get most accurate results.

Fig. 1. Fountain Inn hotel location

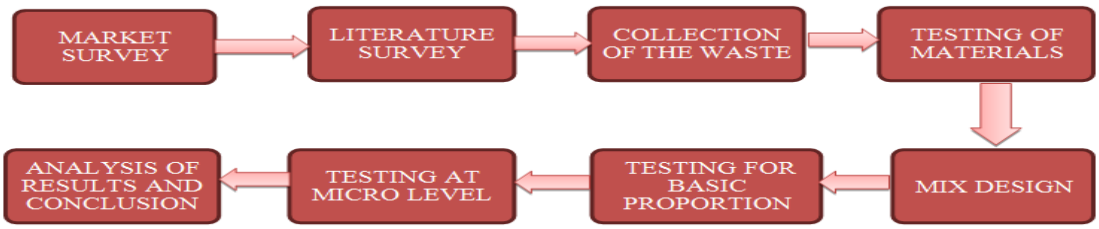


Fig 2. Methodology adopted for paper work

E. Mix Design

As per the Indian standard, Mix design for various proportions which is summarized in the following table, for **stage-I & stage-II.**

Table No:- 3Mix design for Stage-I & Stage-II

	stage-I					stage-II		
Parameter	0%	20%	40%	60%	80%	45%	50%	55%
Cement(Kg)	416	416	416	416	416	416	416	416
Water(Kg)	262	262	262	262	262	262	262	262
Fine Aggregate(Kg)	1019.304	815.44	611.58	407.72	203.86	815.44	611.58	407.72
Fine C&D Aggregate(Kg)	0	176.95	353.9	530.86	707.81	398.14	442.38	486.62
Coarse Aggregate(Kg)	928.224	928.224	928.224	928.224	928.224	928.224	928.224	928.224

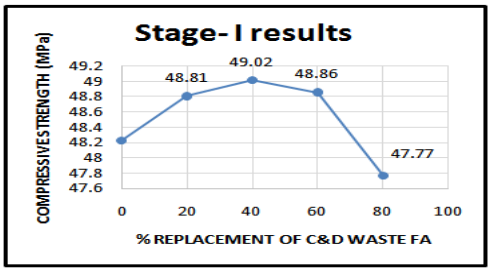
II. Results And Discussion

Table No:- 4Compressive strength results for paver block

	stage-I					stage-II		
Percentage replacement C&D Waste fine aggregate	0%	20%	40%	60%	80%	45%	50%	55%
No. of specimens tested	8	8	8	8	8	8	8	8
Average load obtained	1935.63	1944.83	1967.33	1958.70	1916.93	1983.27	2446.7	1997.54
Compressive strength of paver block	48.23	48.81	49.02	48.86	47.77	49.426	60.97	49.78

A. Results Obtained

Following table shows the average strength obtained for the various proportions of paver blocks for stage-I work.



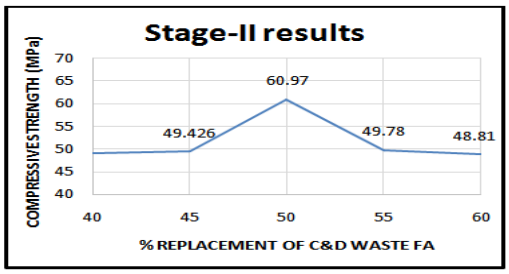


Fig. 3. Stage I compressive strength result fig. 4. Stage II compressive strength result

B. Analysis Of Results

1.After the stage-I testing, it was observed that the maximum compressive strength is achieved in the rage between 40% to 60%.

2. In stage -II results shows that maximum compressive strength is achieved for 50% of replacement of FA

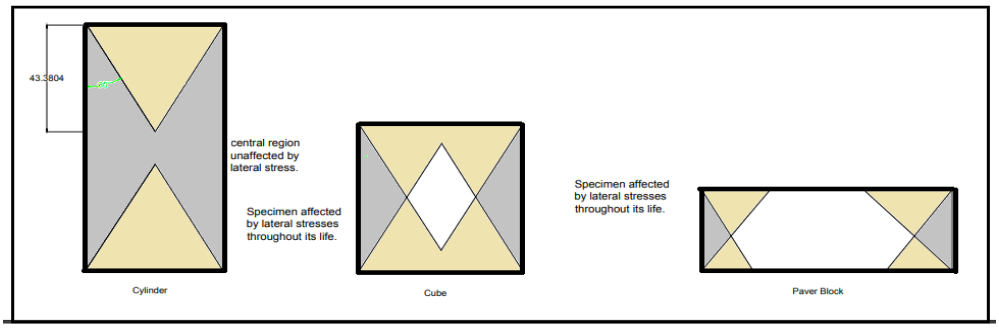


Fig. 5.Base friction

The value of compressive strength of paver block comes on much higher side as compared to its design strength. This increase in strength of paver block is due to its lower thickness.

III. Conclusion

1. Highest compressive strength was achieved when 50% fine aggregate was replaced by C&D waste fine aggregate.
2. The characteristics tensile splitting strength are satisfied.
3. Water absorption by the paver block is within permissible limit.
4. All the samples satisfy the requirement given in IS15658: 2006 for concrete paving blocks to be used in non-traffic areas.
5. This causes up to 25% saving in cost of fine aggregate if 50% FA is replaced by C&D waste FA per cum.
6. It is concluded that the use of C&D waste FA as partial replacement of FA in concrete paving block is possible and this is also helpful in protecting the environment.

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